Original Article

Comparative study of Raja Isteri Pengiran Anak Saleha Appendicitis and modified Alvarado score in the accuracy of diagnosis of the acute appendicitis

Ahmed M. Mansour, Hamed A. Elbadawy and Boshra A. Alhusseini

Department of General Surgery, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt.

ABSTRACT

Background: Accurate diagnosis of acute appendicitis is crucial to avoid complications. The traditional Alvarado score's diagnostic accuracy varies, especially in Asian populations. The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score was developed to address these limitations.

Aim & objectives: This study, conducted at Al Zahraa University Hospital, compares the diagnostic accuracy of the RIPASA score with the modified Alvarado score (MAS) in diagnosing acute appendicitis. The prospective study included 100 patients aged 16–50 years with right iliac fossa pain.

Patients and Methods: Both RIPASA and MAS were calculated for each patient. Of these patients, 58% were male, and 85% were 40 years old or younger.

Results: The RIPASA score ranged from 5.5 to 15, with an average of 9.07±1.66, while the MAS ranged from 1 to 10, averaging 6.22±1.77. The RIPASA score showed a sensitivity of 53.9%, specificity of 77.8%, and accuracy of 71% at a cutoff of greater than or equal to 7.5. In contrast, the MAS showed a sensitivity of 12%, specificity of 100%, and accuracy of 20% at a cutoff of greater than or equal to 7.

Conclusion: We concluded that the RIPASA score had higher sensitivity, specificity, and overall diagnostic accuracy compared with the MAS for diagnosing acute appendicitis in this population. The enhanced diagnostic performance of the RIPASA score supports its reliability as a diagnostic tool.

Key Words: Acute appendicitis, clinical scoring systems, modified Alvarado score, Raja Isteri Pengiran Anak Saleha Appendicitis score.

INTRODUCTION

Acute appendicitis is a prevalent cause of sudden abdominal pain that necessitates surgical treatment. Prompt and precise diagnosis is essential to prevent complications like perforation, abscess formation, and peritonitis, all of which can considerably elevate morbidity and mortality rates. Traditionally, the Alvarado score has been widely used to diagnose acute appendicitis. However, recent studies have suggested that the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score may offer better diagnostic accuracy[1].

The Alvarado score, established in 1986, is a clinical assessment tool that integrates symptoms, physical signs, and laboratory results to estimate the likelihood of acute appendicitis. This score ranges from 0 to 10, with a score of 7 or higher indicating a high probability of appendicitis. The components of the Alvarado score include symptoms such as right lower quadrant pain, anorexia, nausea/vomiting; signs such as tenderness in the right lower quadrant, rebound tenderness, and fever; and laboratory findings such as leukocytosis and a left shift in the differential white blood cell (WBC) count[2].

Despite its widespread use, the Alvarado score has limitations, particularly in specific populations. Studies have shown that its diagnostic accuracy can vary significantly, with lower sensitivity and specificity reported in Asian populations compared with Western ones. This variability has prompted the development of alternative scoring systems, such as the RIPASA score, which is tailored to the clinical and demographic characteristics of these populations[3].

The RIPASA score includes a broader range of clinical parameters than the Alvarado score. It considers additional factors such as age, sex, duration of symptoms, and specific signs such as guarding. Rovsinig's sign, laboratory findings such as negative urine analysis (absence of blood, WBCs bacteria). The RIPASA score ranges from 0 to 15, with scores of 7.5 or higher suggesting a high probability

of acute appendicitis. Preliminary studies indicate that the RIPASA score has greater sensitivity and specificity for diagnosing acute appendicitis compared with the Alvarado score[4].

Given these differences, comparing the RIPASA and modified Alvarado scores' (MAS) accuracy in diagnosing acute appendicitis is clinically significant. This study aims to evaluate and compare the diagnostic performance of both scoring systems to determine which provides a more accurate diagnosis, thereby improving patient outcomes and optimizing resource utilization in clinical settings.

PATIENTS AND METHODS:

This prospective comparative study, was conducted at Al Zahraa University Hospital from July 2023 to January 2024. The study involved 100 patients.

Inclusion criteria

Both male and female, aged between 16 and 50 years, presented with clinical symptoms suggestive of acute appendicitis and subsequently underwent appendectomies.

Exclusion criteria

Patients younger than 16 or older than 50 years were excluded if they exhibited symptoms of an acute abdomen. Additionally, patients presenting with acute abdomen symptoms but later diagnosed with other conditions, such as renal colic, urinary tract infections, ureterolithiasis, pelvic inflammatory disease, ovarian torsion, complicated ovarian cysts, Crohn's disease, diverticular disease, or carcinoma of the caecum, were also excluded.

Ethical considerations

Approval was obtained from the Ethical Committee of the Quality Education Assurance Unit at Al-Azhar University, Faculty of Medicine for Girls, Egypt. The data used in this work were confidential and were used only for scientific purposes.

Preoperative preparation

Patient preparation begins with a comprehensive history collection, detailed examination protocols, focusing on key clinical signs like Rovsing's, Psoas, and Obturator signs to identify appendicitis. Preoperative investigations, comprising laboratory tests (complete blood count, C-reactive protein, urinalysis), radiological assessments (ultrasound, computed tomography scans), and ECG for selected patients.

Scoring system

The RIPASA and MAS are calculated for each patient to standardize the diagnostic approach. These scoring systems combine clinical findings and laboratory results to quantify the likelihood of appendicitis.

The RIPASA Score assigns different points for gender (1.0 for males, 0.5 for females) and age (1.0 for ≤40 years, 0.5 for >40 years). It evaluates symptoms such as right iliac fossa (RIF) pain, pain migration, anorexia, and nausea and vomiting, with specific points for each. The duration of symptoms is also considered, scoring 1.0 for less than 48 h and 0.5 for more than 48 h. Clinical signs like RIF tenderness, guarding, rebound tenderness, and Rovsing's sign have higher scores, reflecting their diagnostic significance. The score also includes laboratory findings, such as raised WBC count and a negative urine analysis, each contributing to the total score, which can reach up to 15. A score of less than 5 suggests that appendicitis is unlikely. Scores between 5 and 7.5 indicate a low probability of appendicitis. A score ranging from 7.5 to 12 signifies a high probability of appendicitis. Scores of 12 and above confirm a definite diagnosis of appendicitis. While, the Alvarado score, includes migration of pain to the right lower quadrant, nausea and vomiting, and anorexia, each scoring 1.0 point. Important signs like tenderness in the RIF are given significant weight with 2.0 points, while rebound tenderness and elevated temperature (>37.3°C) each score 1.0 point. The Alvarado score also emphasizes laboratory findings, assigning 2.0 points for leukocytosis (>10,000/mm³) and 1.0 point for a shift to the left of neutrophils. A score between 6 and 7 points to a low probability of appendicitis. Scores between 7 and 8 suggest a high probability of appendicitis. A score exceeding 8 indicates definite appendicitis[5] (Table 1).

Table 1: Ripasa and alvarado score criteria

RIPASA score		Alvarado score	
Characteristics	Score	Characteristics	Score
Sex			
Male	1.0	–	–
Female	0.5	–	–
Age			
≤40	1.0	–	–
>40	0.5	–	–

| Symptoms			
RIF pain	0.5	Migration of pain to right lower quadrant	1.0
Pain migration to right	0.5	Nausea and Vomiting	1.0
Right iliac fossa (RIF)		Anorexia	1.0
Anorexia	1.0	–	–
Nausea and Vomiting	1.0	–	–
Duration of symptoms			
<48 h	1.0	–	–
>48 h	0.5	–	–
Signs			
RIF tenderness	1.0	Tenderness in RIF	2.0
Guarding	2.0	Rebound tenderness in RIF	1.0
Rebound tenderness	1.0		
Rovsing's Sign	2.0		
Temperature: >37°C <39°C	1.0	Elevated temperature (>37.3°C)	1.0
Labs			
Raised WBC count	1.0	Leukocytosis >10 000 mm³	2.0
Negative urine analysis (Absence of blood, WBCs, bacteria)	1.0	Shift to the left of Neutrophils	1.0
Total Score	15		10

(i) RIPASA score:

    (a) Less than 5: Unlikely appendicitis.

    (b) 5–7.5: Low probability of appendicitis.

    (c) 7.5–12: High probability of appendicitis.

    (d) 12 and above: Definite appendicitis.

(ii) Modified Alvarado score:

    (a) Less than 5: Unlikely appendicitis.

    (b) 6–7: Low probability of appendicitis.

    (c) 7–8: High probability of appendicitis.

    (d) More than 8: Definite appendicitis.

Operative technique for appendectomy

Two surgical techniques were used for appendectomy: Laparoscopic Appendectomy under general anesthesia only and Open Appendectomy under general or spinal anesthesia (Figs. 1, 2) with the prophylactic administration of a third-generation cephalosporin and metronidazole to prevent postoperative infections.
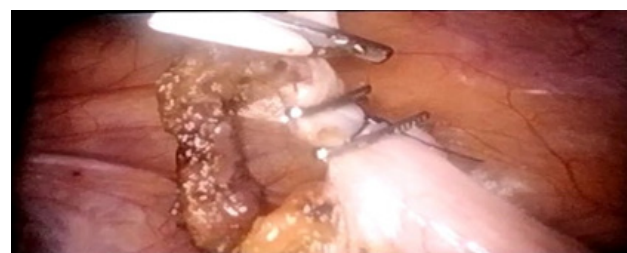
Fig. 1: Clipping and ligation base of appendix in LAP group.

Fig. 2: Ligation of the base after ligation of mesoappendix in open group.

Histopathological examination

The specimens were sent for histopathological assessment at the Histopathology Laboratory of Al Zahraa University Hospital, for assessing pathological dignosis either normal or inflamed (catarrhal, suppurative, complicated).

Postoperative histopathology reports were collected and correlated with either score.

Postoperative care

Postoperative care involves immediate monitoring of vital signs and effective pain management to ensure patient stability and comfort. Recovery is assessed through regular checks for complications such as bleeding, bowel obstruction or infection with prompt intervention as needed. Patients receive instructions on proper wound care to prevent infection and are advised to watch for signs of infection like redness, swelling, or discharge. A gradual reintroduction of food and encouragement of early ambulation help promote recovery and prevent complications such as deep vein thrombosis. Follow-up appointments are scheduled to monitor healing, address concerns, and provide continued support throughout the recovery process.

Statistical analysis

Data were analyzed using IBM SPSS software package version 25.0 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). Qualitative data were described using numbers and percentages. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median, and interquartile range (IQR). Various statistical tests were employed to determine significance and association, including χ^2 test, McNemar's test, correlation analysis, and receiver operating characteristic (ROC) Curve analysis. Significance was judged at the 5% level.

RESULTS:

This study was carried out on 100 patients presenting with clinical symptoms suggestive of acute appendicitis, (Table 2) summarizes the demographic characteristics and clinical history of the studied patients. The age of patients ranged from 17 to 49 years, with a mean age of 30.47±9.0 years. The majority of cases (85%) were less than or equal to 40 years old. More than half of the cases (58%) were male.

Table 3 displays the clinical presentation and examination among the studied cases. The most common symptom was RIF pain, reported in 95% of cases. Pain migration to RIF was observed in 59% of cases, while anorexia and nausea/vomiting were reported in 45% and 34% of cases, respectively. The duration of symptoms was less than 48 h in 71% of cases. Regarding clinical examination, RIF tenderness was present in 90% of patients. Abdominal guarding and rebound tenderness were present in 44% and 54% of cases, respectively. Rovsing's sign was positive in 38% of cases. The mean temperature was 37.79±0.88°C.

Table 4 summarizes the laboratory data. Leukocytosis was observed in 48% of cases, with a mean total leukocyte count (TLC) of 11691.0±4487.5/mm³. Neutrophil shift to the left was noted in 49% of cases, and urine analysis was positive in 53% of cases.

Histopathological analysis, revealed suppurative inflammation in 47% of cases, catarrhal inflammation in 23%, and complicated appendicitis in 21% of cases. No inflammation was found in 9% of cases (Fig. 3).

Table 5 detail the components and total RIPASA and MAS. The total RIPASA score ranged from 5.5 to 15, with a mean of 9.07±1.66. According to the RIPASA score, 84% of cases had a high probability of appendicitis, and 4% had definite appendicitis. While the total MAS ranged from 1 to 10, with a mean of 6.22±1.77. According to this score, 63% of cases had a high probability of appendicitis, and 7% had definite appendicitis.

The comparison between the confirmed positive and negative histology concerning RIPASA and MAS showed no significant difference (*P>0.05*) as indicated in (Table 6). However, the RIPASA score exhibited a significant positive correlation with the MAS (r=0.335, *P=0.001*).

Table 7 presents the ROC curve analysis comparing the RIPASA and MAS. The RIPASA score, with a sensitivity of 53.9%, specificity of 77.8%, and accuracy of 71% at a cutoff of greater than or equal to 7.5 (*P=0.014*), demonstrated significant diagnostic value for acute appendicitis. Conversely, the MAS, at a cutoff of greater than or equal to 7, had a much lower sensitivity of 12%, but a higher specificity of 100%, and a markedly lower accuracy of 20% (*P>0.05*).

Table 2: Demographic characteristics and clinical history of the studied patients

Parameters	Studied cases (*N*=100) *n* (%)
Sex	
Male	58 (58.0)
Female	42 (42.0)
Age (years)	
Mean±SD	30.47±9.0
Median	29.0
Range	17.0–49.0
Age	
≤40 years	85 (85.0)
>40 years	15 (15.0)

SD, standard deviation.

Table 3: Clinical presentation among the studied cases

	Studied cases (*N*=100) *n* (%)
Clinical presentation	
RIF pain	95 (95.0)
Pain migration to RIF	59 (59.0)
Anorexia	45 (45.0)
Nausea and vomiting	34 (34.0)
Examination	
RIF tenderness	90 (90.0)
Abdominal guarding	44 (44.0)
Rebound tenderness	54 (54.0)
Rovsing's sign	38 (38.0)

RIF, Right iliac fossa.

Table 4: Laboratory data among the studied cases

	Studied cases (*N*=100) *n* (%)
Leukocytosis	48 (48.0)
TLC (/mm³)	
Mean±SD	11691.0±4487.5
Median	10500
Range	4500–21000
Neutrophils	
Shift to left	49 (49.0)
Shift to right	51 (51.0)
Urine analysis	
Negative	48 (48.0)
Positive	52 (52.0)
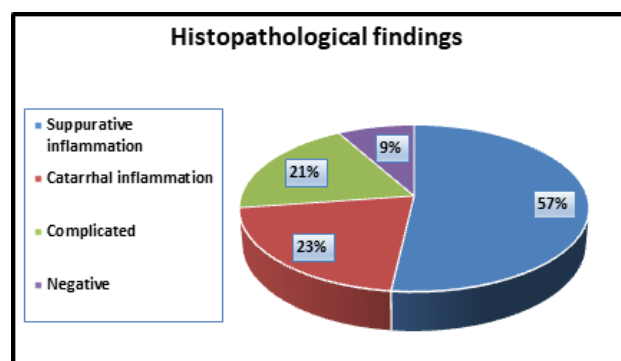
Fig. 3: Distribution of the studied cases regarding histopathological findings.

Table 5: Total RIPASA and modified Alvarado score of the studied patients

Parameters	RIPASA score *N* (%)	Modified Alvarado score *N* (%)
Diagnosis		
Unlikely to be Appendicitis	0	7 (7.0)
Low probability to be Appendicitis	12 (12.0)	23 (23.0)
High probability to be Appendicitis	84 (84.0)	63 (63.0)
Definite appendicitis	4 (4.0)	7 (7.0)
Total score		
Mean±SD	9.07±1.66	6.22±1.77
Median (IQR)	9 (8–10.5)	7 (5–7)
Range	5.5–15	1–10

IQR, Inter-quartile range; SD, standard deviation.

Table 6: Comparison between confirmed positive and negative histology regarding RIPASA score and modified Alvarado score

	Histopathological findings		
	Negative (*N*=9)	Positive (*N*=91)	*P*-value*
RIPASA score			
Mean±SD	8.33±1.5	9.14±1.66	0.141
Median (IQR)	8 (7–9)	9 (8–10.5)	
Range	5.5–10.5	6.5–15	
Modified Alvarado score			
Mean±SD	6.11±0.93	6.23±1.84	0.522
Median (IQR)	6 (5–7)	7 (5–7)	
Range	5–7	1–10	

P less than or equal to 0.05 is considered statistically significant, *P* less than or equal to 0.01 is considered high statistically significant. Mann–Whitney U test.

Table 7: Receiver operating characteristic curve for RIPASA score and modified Alvarado score in detection of acute appendicitis

Parameters	Cutoff	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	*P* value
RIPASA score	≥7.5	0.712	53.9%	77.8%	70.8%	62.8%	71%	0.014
Modified Alvarado score	≥7	0.503	12%	100%	100%	10.1%	20%	0.973

AUC, area under curve; NPV, negative predictive value; PPV, positive predictive value; ROC, receiver operating characteristic curve.

DISCUSSION

The diagnosis of acute appendicitis remains a significant challenge despite its prevalence as a common surgical emergency worldwide. The MAS is widely utilized for diagnosing acute appendicitis; however, its effectiveness is notably reduced in Asian populations. Consequently, the RIPASA score was developed to address this limitation and enhance diagnostic accuracy in these populations[6].

The objective of the present study was to compare the diagnostic accuracy of the RIPASA score and the MAS in identifying acute appendicitis. Our results provide a comprehensive assessment of these two scoring methods, contributing to the existing body of literature and offering valuable insights into their clinical application.

The demographic characteristics of our study sample were in line with previous research findings. The ages of the patients ranged from 17 to 49 years, with an average age of 30.47±9.0 years. There was a higher incidence of cases among patients aged 40 years or younger, with a predominance of males (59%), yielding a male-to-female ratio of 1.38:1. These results are consistent with those of Damburacı *et al*., who observed a mean age of 35 years and 60% of their study population were males[7]. Similarly, Chisthi *et al*. reported a mean patient age of 25.89 (±1.41) years, with a sex distribution of 56% males and 44% females[8].

The clinical symptoms and examination findings in our study cohort were also consistent with those reported in the literature. The majority have pain in the RIF (95%), pain migration (59%), anorexia (45%), and nausea and vomiting (34%). Physical examination revealed RIF tenderness in 90% of patients, abdominal tenderness in 98%, abdominal guarding in 44%, and rebound tenderness in 54%. These symptoms and signs were similarly reported by Zeb *et al*., who noted that the most common symptoms were RIF tenderness, abdominal tenderness, and high temperature[9].

Leukocytosis was present in 48% of our cases, with a mean total leukocyte count (TLC) of 11691.0±4487.5/ mm³. Additionally, 49% of cases had a left shift in neutrophils, and 47% had a negative urine analysis. These laboratory findings corroborate those reported by Damburacı *et al*., who also observed leukocytosis in their study population[7]. Malik *et al*. reported that the included patients had a mean symptom duration of 36.19±15.90 h and a high incidence of leukocytosis, similar to our findings[10]. This consistency across different populations highlights the reliability of leukocytosis as an indicator of acute appendicitis.

Histopathological examination in our study revealed that 47% of cases exhibited suppurative inflammation, 23% had catarrhal inflammation, and 21% were diagnosed with complicated appendicitis. No inflammation was detected in nine cases. These results align with those of Malik *et al*. who reported a high incidence of histologically confirmed acute appendicitis in their cohort[10]. Damburacı *et al*. found that 84% of cases were diagnosed with acute appendicitis based on histopathological examination, with a negative appendectomy rate of 14%[7]. Although slightly higher than our rate, their findings highlight the importance of accurate diagnostic scoring systems to minimize unnecessary surgeries.

Our analysis revealed that the RIPASA score exhibits greater sensitivity, specificity, and diagnostic accuracy compared with the MAS. Specifically, the RIPASA score demonstrated a sensitivity of 83.9%, a specificity of 77.8%, and an accuracy of 71% at a threshold of greater than or equal to 7.5. Conversely, the MAS showed a sensitivity of 12%, a specificity of 100%, and an accuracy of 20% at a threshold of greater than or equal to 7.

Numerous studies have evaluated the diagnostic performance of the RIPASA score against the MAS, consistently indicating that the RIPASA score outperforms the MAS in sensitivity, specificity, and overall diagnostic accuracy. For example, a study at Patan Hospital reported the RIPASA score's sensitivity and specificity as 98.71% and 80.00%, respectively, compared with the MAS's 52.56% and 70%[11]. Similarly, research at Bab-EL-Sharia Hospital found that the RIPASA score had a diagnostic accuracy of 84.5%, significantly surpassing the MAS's 59.5%[12].

The RIPASA score's superior performance across various populations underscores its reliability as a diagnostic tool. In a study at Aseer Central Hospital, the RIPASA score demonstrated better sensitivity (96.2%) and diagnostic accuracy (85.0%) than the MAS in a Saudi population[13].

These findings are corroborated by Damburacı *et al*., who confirmed the RIPASA score's superior diagnostic performance over the MAS[7]. Similarly, Chisthi and colleagues reported a negative appendectomy rate of 15.89%, with RIPASA scores between 5 and 12 and MAS between 4 and 9. Their study indicated a mean RIPASA score of 8.91 (±2.83) and a mean Alvarado score of 7.33 (±2.12), highlighting the RIPASA score's higher predictive accuracy[8].

Numerous comparative studies consistently emphasize the benefits of the RIPASA score in diagnosing acute appendicitis. Karami *et al*. found the RIPASA score had a sensitivity of 93.1% and a

specificity of 91.6%, with a significantly larger ROC curve area than the Alvarado score[14], supporting our findings. Similarly, Mehbub *et al*. concluded that with a cut-off value of greater than or equal to 7.5, the RIPASA score is a superior diagnostic tool for acute appendicitis compared with the MAS[15], corroborating our results of higher sensitivity, specificity, and diagnostic accuracy.

Our study's findings have important clinical implications. The higher sensitivity and diagnostic accuracy of the RIPASA score suggest it is a more reliable tool for diagnosing acute appendicitis, especially in settings with limited access to advanced diagnostic imaging. Its simplicity and ease of calculation make the RIPASA score a practical choice for clinicians, aiding in prompt and accurate decision-making.

CONCLUSION

The RIPASA scoring system exhibited higher sensitivity, a better negative predictive value, and greater overall diagnostic accuracy compared with the MAS for diagnosing acute appendicitis in our study population. These results highlight the effectiveness of the RIPASA score as a quick and reliable tool for assessing patients with suspected appendicitis, reducing the reliance on diagnostic imaging, and potentially improving patient outcomes.

CONFLICT OF INTEREST

There are no conflicts of interest.

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